DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
Submission of Proposals

DARPA's charter is to help maintain U.S. technological superiority over, and to prevent technological surprise by, its potential adversaries. Thus, the DARPA goal is to pursue as many highly imaginative and innovative research ideas and concepts with potential military and dual-use applicability as the budget and other factors will allow.

DARPA has identified technical topics to which small businesses may respond in the second fiscal year (FY) 2000 solicitation (2000.2). Please note that these topics are UNCLASSIFIED and only UNCLASSIFIED proposals will be entertained. These are the only topics for which proposals will be accepted at this time. A list of the topics currently eligible for proposal submission is included, followed by full topic descriptions. The topics originated from DARPA technical program managers and are directly linked to their core research and development programs.

Please note that **1 original and 4 copies** of each proposal must be mailed or hand-carried. DARPA will **not** accept proposal submissions by electronic facsimile (fax). A checklist has been prepared to assist small business activities in responding to DARPA topics. Please use this checklist prior to mailing or hand-carrying your proposal(s) to DARPA. Do not include the checklist with your proposal.

- DARPA Phase I awards will be Firm Fixed Price contracts.
- Phase I proposals **shall not exceed $99,000**.
- DARPA Phase II proposals must be invited by the respective Phase I program manager (with the exception of Fast Track Phase II proposals -- see Section 4.5 of this solicitation) . DARPA Phase II proposals must be structured as follows: the first 10-12 months (base effort) should be approximately $375,000; the second 10-12 months of incremental funding should also be approximately $375,000. The entire Phase II effort should generally not exceed $750,000.
- It is expected that a majority of the Phase II contracts will be Cost Plus Fixed Fee.

Prior to receiving a contract award, the small business **MUST** be registered in the Centralized Contractor Registration (CCR) Program. You may obtain registration information by calling 1-800-334-3414 or Internet: http://ccr.edi.disa.mil. The small business **MUST** also have a Commercial & Government Entity (CAGE) Code. This code is part of the CCR registration package. For information call 1-888-352-9333 (Press 3) or 1-888-227-2423 or Internet: www.ccr.dlsc.dla.mil.

The responsibility for implementing DARPA's SBIR Program rests with the Contracts Management Office (CMO). The DARPA SBIR Program Manager is Ms. Connie Jacobs. DARPA invites the small business community to send proposals directly to DARPA at the following address:

DARPA/CMO/SBIR
Attention: Ms. Connie Jacobs
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 526-4170
Home Page http://www.darpa.mil

SBIR proposals will be processed by the DARPA Office of Contract Management and distributed to the appropriate technical office for evaluation and selection.

DARPA selects proposals for funding based on technical merit and the evaluation criteria contained in this solicitation document. DARPA gives evaluation criterion, "The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution" (refer to Evaluation Criteria in solicitation), twice the weight of the other two evaluation criteria. As funding is limited, DARPA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and highly relevant to the DARPA mission. As a result, DARPA may fund more than one proposal in a specific topic area if the technical quality of the proposal(s) is deemed superior, or it may not fund any proposals in a topic area. Each proposal submitted to DARPA must have a topic number and must be responsive to only one topic.

- Cost proposals will be considered to be binding for 180 days from solicitation closing date.
- For contractual purposes, proposals submitted to DARPA should include a statement of work, which does not contain proprietary information.

- Successful offerors will be expected to begin work no later than 28 days after contract award.

- For planning purposes, the contract award process is normally completed within 45 to 60 days from issuance of the selection notification letter to Phase I offerors.

The DOD SBIR Program has implemented a streamlined Fast Track process for SBIR projects that attract matching cash from an outside investor for the Phase II SBIR effort, as well as for the interim effort between Phases I and II. Refer to Section 4.5 for Fast Track instructions. **DARPA encourages Fast Track Applications between the 5th and 6th month of the Phase I contract. Phase II proposals are due no later than 30 days after the Fast Track Application has been accepted. Technical dialogues with DARPA Program Managers are encouraged to ensure research continuity during the interim period and Phase II. If a Phase II contract is awarded under the Fast Track program, the amount of the interim funding will be deducted from the Phase II award amount. It is expected that interim funding will not exceed $40,000.**

To encourage the transition of SBIR research into DOD Systems, DARPA has implemented a Phase II Enhancement policy. Under this policy DARPA will provide a Phase II company with additional Phase II SBIR funding, not to exceed $200K, if the company can match the additional SBIR funds with non-SBIR funds from DOD core-mission funds, the private sector, or at the discretion of a DARPA Program Manager. DARPA will generally provide the additional Phase II funds by modifying the Phase II contract.

The Point of Contact for general / administrative questions about the DARPA SBIR program is:

DARPA/CMO/SBIR
Ms. Connie Jacobs
3701 North Fairfax Drive
Arlington, VA 22203-1714
(703) 526-4170

Additional information about DARPA and its SBIR program can be found on the DARPA Home Page at http://www.darpa.mil.

The Points of Contact for technical questions about the topics, during the Pre-Solicitation period only, are listed below. E-mail is the most effective means of communicating with DARPA Program Managers. If you have difficulty reaching a designated POC, please contact Connie Jacobs directly at cjacobs@darpa.mil; she will follow-up on your inquiry.

DARPA 2000.2 Phase I SBIR
Checklist

1) Proposal Format

   a. Cover Sheet (formerly referred to as Appendices A and B) **MUST** be submitted electronically (identify topic number) ______

   b. Identification and Significance of Problem or Opportunity ______

   c. Phase I Technical Objectives ______

   d. Phase I Work Plan ______

   e. Related Work ______

   f. Relationship with Future Research and/or Development ______

   g. Commercialization Strategy ______

   h. Key Personnel, Resumes ______

   i. Facilities/Equipment ______

   j. Consultants ______

   k. Prior, Current, or Pending Support ______

   l. Cost Proposal (see Reference A of this Solicitation) ______

   m. Company Commercialization Report (formerly referred to as Appendix E) ______
   MUST be registered electronically
   (register at http://www.dodsbir.net/submission)
   (include signed hard copy along with proposal)

2) Bindings

   a. Staple proposals in upper left-hand corner. ______

   b. **Do not** use a cover. ______

   c. **Do not** use special bindings. ______

3) Page Limitation

   a. Total for each proposal is 25 pages inclusive of cost proposal and resumes. ______

   b. Beyond the 25 page limit do not send appendices, attachments and/or additional references. ______

c. Company Commercialization Report (formerly referred to as Appendix E) is not included in the page count. ______

4) Submission Requirement for Each Proposal

a. Original proposal, including signed Cover Sheet (formerly referred to as Appendix A) ______

b. Four photocopies of original proposal, including signed Cover Sheet and Company Commercialization Report (formerly referred to as Appendices A, B and E) ______

INDEX OF DARPA FY2000.2 TOPICS

SUBJECT/WORD INDEX TO THE DARPA FY2000.2 TOPICS

Subject/Keyword Topic Number

DARPA 2000.2 TOPIC DESCRIPTIONS

SB002-034 TITLE: High Level Light Protection of an Imaging Sensor

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop in-band protection of infrared (IR) imaging sensor against both saturation and permanent damage while providing adequate throughput for continued operation.

DESCRIPTION: Micro electromechanical system (MEMS) sensor and actuator technology is rapidly providing solutions to a variety of commercial and military applications in terms of size, performance, and cost. Photonic band gap (PBG) materials are a research novelty approaching a stage of development for application demonstration. PBGs have been demonstrated to provide broadband filtering of light. It is believed that the merger of these two technologies may provide a system suitable to meet various sensor shielding requirements. PBGs may be used to provide high light throughput and broadband passive filtering. MEMS actuators may be utilized to switch between passive out-of-band protection and a highly blocking mechanism for temporal in-band protection against saturation or permanent damage of the sensor. The concept design should consider that the imaging sensors are designed for the 3-5 and 8-12 microns of wavelength. A typical geometry of the imaging sensor consists of a multi-pixel array of detector elements.

PHASE I: Develop the full concept design that provides passive out-of-band shielding and MEMS micro-actuators to switch between broadband detection and in-band protection against temporally varying conditions. The blocking mechanism of in-band protection should be non-absorptive, highly reflective, and insure that the sensor is not totally blinded. Successful completion of Phase 1 should include a breadboard demonstration of the basic concept with supporting data.

PHASE II: Fabricate hardware capable of field tests based upon the Phase I concept and conduct a demonstration, which proves the effectiveness of the hardware.

PHASE III DUAL USE APPLICATIONS: The ability to manufacture transparent metal films and control the band pass and attenuation of transmission of infrared energy through such film should have wide ranging commercial use many of which cannot be envisioned today. Those which can be foreseen include protective coatings for sensors in manufacturing facilities, protection for satellite imaging sensors, controllable emissivity of window glass which controls both heat loss as well as visibility, and radio frequency shielding while allowing transmission of visible light.

KEYWORDS: MicroElectroMechanical Systems, MEMS, Photonic Band Gap Material, PBG, Imaging Infrared, IIR.

REFERENCES:

1. http://www.darpa.mil/MTO/MEMS/index.html
2. http://www.ida.org/MEMS
3. Journal of Lightwave Technology, special issue on Electromagnetic Crystal Structures (Photonic Band Gaps), vol. 17, November, 1999.
4. Microcavities and Photonic Bandgaps: Physics and Applications, J Rarity and C. Waisbuch, Eds., Norwell, MA, Kluwer Academic Pulblishers, 1996.

SB002-035 TITLE: Compliant Surface Robotics

TECHNOLOGY AREAS: Ground/Sea Vehicles

OBJECTIVE: This SBIR topic calls for innovative research into hybrid locomotion and variable traction techniques that can efficiently adapt to environmental conditions and compensate for the daunting locomotion challenges inherent with compliant surfaces such as deep snow, sand, etc. The fact that mobile robots do not have to accommodate human passengers prompts us to re-examine locomotion techniques in a much more innovative and highly unconstrained manner relative to the automotive industry and traditional vehicle development efforts.

DESCRIPTION: Current locomotion techniques for mobile robots generally fall into one of three categories: tracks, wheels, or legs. While interesting progress has been made in each of these areas, current capabilities for each tend to be inefficient and failure intensive when maneuvering through compliant surfaces. Innovative research is sought in adaptive materials and system design that will allow a mobile robot to radically alter its locomotion technique to compensate for environmental change (deep snow) or negotiate compliant surface obstacles such as deep sand, mud, etc. Particular areas of interest include:

- variable texture materials that can radically alter friction coefficients on the fly to improve traction, reduce drag, etc. as a means to compensate for the sudden appearance of compliant surface obstacles, and compensate for variable particle densities
- hybrid mobility techniques that combine legs with tracks, wheels with legs, etc. to be able to adapt to complex obstacles (rocks covered by snow, lattice structures, etc.)
- variable volume techniques (radically expandable chassis, wheels, tracks, telescoping legs, etc) that will allow a robot to widely distribute loads as needed to avoid deep penetration into problematic surface densities (snow, sand, etc.) – note that this cannot be done with traditional manned vehicles without squashing passengers, severing limbs, etc.
- variable porosity materials electro-active polymers
- perceptual mechanisms that can detect and characterize compliant surfaces enough to trigger adaptive responses (change in texture, volume, configuration, etc.)

The operational intent is to enable advanced mobility through environmentally sensitive areas where ground maneuver tends to bog down with inefficiency and a highly overt signature (e.g. deep, well-defined tracks are left everywhere you go). Efforts may address any innovative design that can provide mobile robots with an ability to perceive a feature-sparse compliant surface (e.g. a snowfield that covers recognizable landmarks such as trails, streams, etc.) and adapt its locomotive mechanisms to maneuver efficiently through it.

PHASE I: Define the innovative approach in detail and describe enabling technologies that will address design and integration challenges associated with compliant surfaces. Penetrating sensors that can determine snow depth, sand density, etc. are of particular interest in pursuit of a comprehensive mobility system. Present a basic design that will address the objectives indicated above.

PHASE II: Design and build a functional, portable (<10kg) robotic platform that is capable of maneuvering semi-autonomously through deep snow, sand, mud, etc. with minimal impact on its surface (<5psi over pressure. Present analysis of scaling relationships that address the potential for transition to larger platforms as needed to support advanced mobility objectives of various DoD programs such as the Army's Future Combat System.

PHASE III DUAL USE APPLICATIONS: Portable robotic platforms have been envisioned for a variety of SAR (Search and Rescue) activities assets since the SOFROB (Special Operations Robotics) and KNOBSAR (Knowledge Base for Search and Rescue) projects were initiated in 1994. Operational experience in a variety of extreme environment reconnaissance missions (arctic, desert, jungle etc.) indicates that agile and efficient robotic platforms could be of enormous value in negotiating large compliant surfaces in search of avalanche victims or to locate sub-surface anomalies, hazardous materials etc. Note that most avalanche mitigation today is done by explosives or 75mm cannons that tend to be dud-intensive (when fired into soft snow), and inefficient (tough to drop charges from a helicopter in a blizzard-precisely when it needs to be done).

KEYWORDS: Robotics, Artificial Intelligence, Computer Science, Electronic System Design, Reconnaissance, Surveillance, Target Acquisition, RSTA, Search and Rescue, SAR, Avalanche Mitigation.

SB002-036 TITLE: Electromagnetic Metamaterials for Microwave Applications

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics, Battlespace

OBJECTIVE: Development and implementation of "metamaterials" for microwave telecommunication and wireless power transfer applications.

DESCRIPTION: Metamaterials are composite materials that, due to their engineered microstructure, exhibit response functions superior to the intrinsic properties of the constituent materials. Artificial ferrites and artificial dielectrics are examples of metamaterials that have been shown to exhibit superior microwave properties over a limited frequency range. Recent progress in the microfabrication technologies suggest the possibility of realizing increasingly complex metamaterial architectures which are theoretically predicted to exhibit loss and dispersion properties that can be optimized over a broad range of microwave frequencies.1,2 Expanding the frequency range over which these improved properties exist would offer new opportunities to antenna engineers who frequently find the microwave losses of conventional materials (typically ferrites) to be the limiting factor in their ability to design electrically small, lightweight, and efficient antennas. The need for better materials is driven by the proliferation of antennas and the requirement for small, lightweight rectennas (rectifying antennas) for conversion of microwave to dc power. The main goal of this topic is to expand the design space available to antenna engineers by promoting research and development of novel metamaterials that exhibit microwave properties superior to conventional ferrites over a broad frequency range.

PHASE I: Demonstrate a reproducible and scalable process for fabricating metamaterials which exhibit microwave properties superior to conventional ferrites and which can be implemented in an antenna or rectenna application.

PHASE II: Implement the Phase I metamaterials in one or more components of a particular microwave (e.g. antenna or rectenna) application and demonstrate the metamaterial advantage on the system performance.

PHASE III DUAL USE APPLICATIONS: Metamaterials with superior microwave properties would result in smaller, more robust, and more efficient, radar and telecommunication systems for both the military and commercial industry. The development of these materials is an enabling technology for wireless power transfer applications. Wireless power transfer would enhance current abilities to provide power to remote commercial and military airborne platforms and is a crucial element in the development of high power microwave directed energy weapons.

KEYWORDS: Metamaterials, Microwave Devices, Radar, Telecommunications, Artificial Dielectrics, Artificial Molecules, "Smart" Skins, Wireless Power Transfer, Ferromagnetic Thin Films.

REFERENCES:
1. "Shape-Optimized Ferromagnetic Particles with Maximum Theoretical Microwave Susceptibility", Walser, R.M., Win, W., and Valanju, P.M., IEEE Transactions on Magnetics 34 (4), 1390-1392 (1998).
2. "Passive Artificial Molecule Realizations of Dielectric Materials", Ziolkowski, R. W., Auzanneau, F., Journal of Applied Physics 82 (7), 3195-3198 (1997).

SB002-037 TITLE: Damage Tolerant Amorphous Metal Alloys

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Investigate the synthesis and processing of bulk amorphous metal alloys exhibiting enhanced structural properties.

DESCRIPTION: The Defense Advanced Research Projects Agency (DARPA) is soliciting innovative research proposals in the area of bulk amorphous metal alloys. Amorphous alloys exhibit unique combinations of hardness, strength, and damage tolerance as a result of their novel microstructure and its evolution during devitrification. Specific DoD interests include corrosion-resistant reduced magnetic mass hull materials, elevated temperature lightweight alloys for aircraft and rocket propulsion, and wear resistant machinery components for ground vehicles and helicopters. DARPA seeks SBIR Phase I innovative proposals that demonstrate the feasibility and synthesis of amorphous alloys based on Al, Fe, Mg and Ti metal systems. Proposed research should investigate innovative compositions and synthesis approaches that enable the amorphous state to be retained without the need for fast (>103ºC/sec) cooling rates. Compositions and processes that result in compelling combinations of useful structural properties and are conducive to large scale and environmentally benign manufacturing practices are sought.

PHASE I: Phase I efforts will identify and demonstrate compositions and processes for the synthesis and processing of amorphous alloys for structural applications. Laboratory-scale tests on these materials will be conducted.

PHASE II: Phase II will investigate optimization and production of materials and demonstrate performance on a laboratory scale in an application of interest to the Department of Defense.

PHASE III DUAL USE APPLICATIONS: Amorphous alloys offer the potential for use as extremely tough, moderate temperature, corrosion resistant structural alloys for use in military air, ground, and sea vehicles. Applications can also be found in the commercial automotive, chemical, and structural materials markets.

KEYWORDS: Metal Alloys, Structural Materials, Corrosion Resistant Materials, High Toughness Materials, Materials Processing.

REFERENCES:
1. A Peker and W.L. Johnson, Appl. Phys. Let. 63, 2342 (1993)
2. T. Zhang, A. Inoue and T. Masumoto, Mater. Trans. Japan Inst. Metals, 32, 1005, (1991)
3. P. Lowhaphandu, S.L. Montgomery and J.J. Lewandowski, Script. Metal., 41, 19, (1999).

SB002-038 TITLE: Active Response Technology (ART)

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Creation of novel cyber attack assessment and response technologies that go significantly beyond the realm of conventional approaches to defensive information warfare. These technologies will provide decision-makers with high-level information, enabling an appropriate course of action and response to an information attack to be determined.

DESCRIPTION: DARPA is soliciting research and development proposals for defense against cyber-attack that present a radical strategic departure from the conventional detection and defense technologies for information warfare, such as sensors, statistical detection, firewalls, and static defenses. The new technologies should take a pro-active posture attempting to intercept, track, redirect, and respond to coordinated attacks. Defensive actions might be taken for the purpose of gaining intelligence on the source, identity, and goals of an adversary as well as simply frustrating the attack. The technologies may utilize a wide variety of counter-offensive techniques, such as localized jamming, network blocking, traffic redirection and compartmentalization, network component masquerading, reverse denial of service, network re-mapping, traffic corruption, and fingerprinting. Responses should be capable of confounding the attacker rather than simply attempting to block entry to system structures. Specifically consider techniques that counter insider attacks based on familiar notions of cross checking, ambush, coercion, and deception. The technologies may make use of novel concepts from CyberForensics. However, if so, they must push the art of CyberForensics significantly beyond the realm of post-mortem data collection and analysis. In particular, the technologies must provide the ability to give decision-makers high-level reports or stimulus on-the-fly during an attack. These reports must be timely enough and provide appropriate information to help determine an appropriate course of action or response to information warfare attack.

PHASE I: Define a forensic or active response capability, suggest methods of achieving it, and a general approach to implementation and integration with existing defensive information warfare structures or technologies. Quantify the expected benefits and capabilities for system administrators and users.

PHASE II: Implement a commercial plug-and-play component for forensics or active response that can stand-alone or inter-operate with an appropriate forensic architecture. The technology should allow the appropriate information to be displayed to a decision-maker. Validate the component through representative attacks. Complete tools, documentation, tests, integration notes, and results must be delivered.

PHASE III DUAL USE APPLICATIONS: Real-time cyber attack assessment and response technologies have direct relevance to the security and reliability of all forms of electronic commerce. Large commercial networks are continually under cyber attack using very similar attacks to those perpetrated against military information infrastructures. Tools and strategies that provide additional alternatives to present reactive mechanisms will be of interest in many large network operations centers. The technologies would provide methods to isolate, track, and respond to perpetrators of malicious intrusion, fraud, corporate piracy, and espionage. Furthermore, insider attack in particular is by far the most prevalent and difficult-to-detect method of intrusion in modern commercial infrastructures. Since these attacks make use of legitimate access authorizations, conventional defenses such as sensors and firewalls offer little or no protection, tracking, or deterrence. There is thus a significant commercial opportunity in the development of practical software tools that aid corporations in this area. The novel technologies to be developed in this topic area will be applicable to all corporate electronic commerce and especially to large, national and international scale corporations.

KEYWORDS: Cyber Response, Computer Network Defense, Computer Forensics, CyberForensics, Electronic Commerce, Information Attack, Electronic Trade, Antiterrorism, Corporate Piracy, Systems Intrusion, and Information Warfare.

REFERENCES:
Good surveys on the kinds of attack that are perpetrated against e-commerce can be found in:
1. 1999 CSI/FBI Computer Crime and Security Survey, published by the Computer Security Institute (www.gocsi.com).
2. I-Way Robbery: Crime on the Internet, William C. Bonni and Gerald L. Kovachich, Butterworth-Heinemann, 1999, ISBN 0-7506-7029-9.
3. Financial Services in the Digital Age: The Future of Banking, Finance, and Insurance, Paul Gosling, Bowerdean Publishing Co. Ltd. 1996, ISBN 0-906097-54-1.

Good overviews of current protective mechanisms and strategies can be found in the books:
1. Internet Security for Business, Burnstein et al, Wiley, 1998, ISBN 0-471-13752-9.
2. E-commerce Security: Weak Links, Best Defenses, Anup Ghosh, Wiley, 1998.

Good overviews of current CyberForensics techniques and strategies can be found in:
1. Computer Forensics in the New Millennium, James O. Holley, SC Info Security News Magazine, Sept 1999, pp 46-52.
2. Special Issue on Computer Forensics, SC Info Security News Magazine, October 1998.

SB002-039 TITLE: Active Profiling for Insider Threat

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: Research and development of mechanisms to identify and react to anomalous behavior of users and software applications within information systems.

DESCRIPTION: An important thrust for detection of malicious insider activity on an information system is by profiling behavior of the users and privileged applications. While this concept is not new, insufficient research and development has been focused to identify the proper mechanisms, measures, and factors for anomalous insider activity. Examples of such profiling include information as those files and processes normally accessed, periods of time that user is normally logged in or an application executes, keystroke patterns, and a wide variety of other attributes. With such profiles available, it is then possible to develop anomaly detection for unauthorized results that have not been previously encountered. Of key importance in producing reliable and useful mechanisms are low false positive rate, high detection of actual anomalous behavior, and a low overhead burden for the detection software on the system.

PHASE I: Develop active techniques for profiling users and applications that will discriminate between normal and anomalous behavior for a given user, be able to discriminate among users, and identify new insider-initiated misuse. Through experimentation with real system data, identify, develop, and rank multiple techniques that minimize false positives and performance overhead while maximizing detection of real events. Identification of behavioral deviance is expected; however, the ability for intent inference has the promise of detecting a wider range of insider misuse.

PHASE II: Develop active response options given categories and types of promising insider anomaly detection in Phase I. Map appropriate responses to possible detections and provide a method for balancing the negative effect of a response on the system versus consequence for inaction considering both automated and human-reviewed options. Demonstrate the viability of responses to active profiling through a series of small experiments that measure the performance of detection and response. Also extend the work of Phase I by refining the most promising techniques as well as identifying the shortcomings of other techniques to determine their viability given further research.

PHASE III DUAL USE APPLICATIONS: Industry has already accepted virus protection software as standard business practice. This and other internal network auditing software has primed commercial markets for acceptance of a capability to detect and react to anomalous insider behavior. Insider threat is already acknowledged by industry as a problem that they wish to, but cannot properly address. The same is true for DoD, which has an urgent need for a reliable detection capability on its information systems. Therefore work in this area will have a direct conduit for successful Phase III activity.

KEYWORDS: Anomaly Detection, Insider Threat, Malicious Activity, Machine Learning, Profiling, Anomalous Behavior.

REFERENCES:
1. Workshop results "Research and Development Initiatives Focused on Preventing, Detecting, and Responding to Insider Misuse of Critical Defense Information Systems," August 16-18, 1999, RAND, Santa Monica CA, sponsored by NSA/R2, DARPA/ISO, and the Army Research Laboratory, http://www2.csl.sri.com/insider-misuse/.
2. "Learning Program Behavior Profiles for Intrusion Detection," A. Ghosh, A. Schwartzbard, M. Schatz, USENIX Workshop on Intrusion Detection and Network Monitoring, April 1999, abstract:
http://www.usenix.org/publications/library/proceedings/detection99/ghosh.html
full paper: ftp://ftp.rstcorp.com/pub/papers/usenix_id99.ps.
3. "Detecting intrusions using system calls: Alternative data models," C. Warrender, S. Forrest, B. Pearlmutter, IEEE Symposium on Security and Privacy, 1999, ftp://ftp.cs.unm.edu/pub/forrest/oakland-with-cite.pdf.
4. "The Challenges of Insider Misuse," Peter G. Neumann, SRI Computer Science Lab, Post-workshop version, 23 August 1999, http://www.csl.sri.com/neumann/pgn-misuse.html.
5. "Physical security, The danger within: Internal employees - not outside hackers - can be a time bomb waiting to blow," Deborah Radcliff, Infoworld 20 April 1998.

SB002-040 TITLE: Malicious Firmware Assurance

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Research and development of mechanisms to provide assurance of information systems from malicious code and functions contained in system firmware.

DESCRIPTION: Malicious code is a broad topic of concern for the assurance of information systems and effective use by the warfighter as they use computer and software technology. Announcements of "Easter eggs" in commercial software and recent Y2K remediation efforts have increased awareness that software may contain undesirable code that could result in malicious activity and potentially grave results. This usually software-specific problem is of growing concern for firmware (such as BIOS, internal processors) due to increasing hardware portability and interchangeability, on-board peripheral capabilities including processing and multi-use non-volatile memory, and ability for remote configuration. Efforts are sought that will reveal the fundamental mechanisms for firmware's affect on assurance of information systems and methods that may be used to detect and mitigate malicious firmware behavior. The scope of this work may be limited to an individual workstation; however, due to the prevalence of networked components, the goal is to extend understanding to network-based enclaves.

PHASE I: Research areas include but are not limited to defining effective models of firmware assurance behavior, detecting and understanding configuration of a system as it changes, authentication of existing and added components and their behavior, and engineering processes for inherent assurance of firmware. All efforts should include measuring performance parameters for a science-based understanding of the technique's utility and effectiveness such as system performance effects, risk mitigation, and increase in adversary work factor.

PHASE II: Create a system that demonstrates one or more methods for assurance of information systems from malicious firmware behavior. Perform controlled experiments that measure the ability of the mechanisms to prevent and detect such activity. Complete documentation of research, experimentation, and results is required.

PHASE III DUAL USE APPLICATIONS: The ability to understand effects of firmware behavior is inherently dual use because it provides for better understanding and control the assurance of information systems. COTS providers are becoming increasingly aware of the marketability of assuring their products for customers (inherently sound hardware/firmware design included). As their efforts rely more heavily on information systems and communications, warfighters will have an increasing need to understand whole-system assurance, including how trustworthy their components are and if component behavior is changing or becomes anomalous.

KEYWORDS: Malicious Code, Malicious Firmware, Systems Information Assurance, Assurance of Peripherals, Anomaly Detection, Integrity Checking, Authentication, Fault-Tolerance, Reverse Engineering, Firmware Inspection.

REFERENCES:
1. Results, Malicious Code ISTSG (Infosec Science and Technology Study Group), initial meeting and first workshop, chartered by the Infosec Research Council (IRC), 15 October 1999, 13 January 2000, http://www.rstcorp.com/irc/, http://www.rstcorp.com/irc/meeting-2.html.
2. "A Secure and Reliable Bootstrap Architecture," Arbaugh, W.A., D. J. Farber, J. M. Smith, Proc. 1997 IEEE Symposium on Security and Privacy, pp. 65-71.

SB002-041 TITLE: Analysis and Simulation of Integrated Microsystems for Detection of Chemical and Biological Agents

TECHNOLOGY AREAS: Information Systems, Electronics

OBJECTIVE: Development of data, models and algorithms for quantitative analysis and design of bio-molecular microsystems for chemical/biological detection.

DESCRIPTION: Integrated microsystems offer the potential to significantly improve the speed, sensitivity, efficiency and affordability of chemical processing and analysis. The design of bio-molecular micro/nano-systems for sensing applications requires the integration of several different technologies (such as chemistry, biology, fluidics, electronics, optics, mechanics, etc.) on the chip scale. The optimal engineering of such systems requires the quantitative understanding of the interactions between the different technologies. The primary thrust of this effort is to obtain a quantitative characterization of (i) the micro/nano bio-fluidic transport, (ii) the bio-molecular recognition process, and (iii) the transduction of the molecular recognition signal into an electrical or optical or mechanical signal. Proposals are sought in the areas of fundamental experimental measurements as well as computational modeling/simulation tools to gain a quantitative description of the above processes.

PHASE I: Identify and define the processes/systems to be characterized. Demonstrate feasibility of using data and models to obtain a quantitatively correct description (and scaling laws) of the microsystem behavior. Examples include chemical kinetics of molecular recognition processes, correlation of transduced signal intensity to the concentration of the detected molecules in the sample, and transport of non-homogeneous fluids (containing cells, beads and complex molecules) in the mircosystem.

PHASE II: Use the models and scaling relationships to predict microsystem performance over a range of operating conditions, perform detailed model validation and demonstrate the feasibility of using the models for design/development of improved microsystems. Complete documentation of the data, models, test cases and results must be delivered.

PHASE III DUAL USE APPLICATIONS: The development of data and computational models will form the groundwork for advanced computer aided design (CAD) tools for routine analysis and design of integrated microsystems. CAD tools will enable exploration of novel device concepts and designs, improvements in device performance/reliability and reduction in product time-to-market. These developments will have significant impact in the areas of national chemical/biological-warfare defense, healthcare, clinical and infectious disease monitoring, drug delivery systems, lab-on-a-chip diagnosis/analysis systems, nanobiotechnology, etc.

KEYWORDS: Bio-Molecular Microsystems, Microfluidics, Computational Models, CAD Tools, Molecular Recognition, Signal Transduction.

REFERENCES:
1. H. Ackler, P. Krulevitch, R. Miles, B. Benett, S. Swierkowski, V. Malba, P.R.C. Gascoyne, X-B. Wang, and G. DeGasperas "Microfluidic systems for electrochemical and biological studies", Proc. 194th Meeting of the Electrochemical Society, Boston, MA, November 1-6, 1998.
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SB002-042 TITLE: Integrated Electronic/Photonic Cooling Devices Based on Hot Electron Emission

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop solid state electronic technology based on hot electron emission for cooling integrated microelectronic and optoelectronic devices.

DESCRIPTION: Electron emitting structures in vacuum, particularly those fabricated from wide band gap semiconductor materials such as GaN and its related compounds, diamond, and SiC, have the potential to be used in cooling of integrated microelectronics via the Nottingham effect, which depends on emitted hot electrons. Novel approaches to fabrication and optimization of emission characteristics and geometries, which can be integrated together with working microelectronic/optoelectronic modules are solicited. Such methods may also employ non-isothermal electron transport over heterostructure barriers. Preliminary results demonstrating that cooling can be achieved in conventional III-V heterostructures have been reported in the literature [1,2,3]. A desirable thermionic cooler ought to be capable of producing emission currents greater than 100 A/cm2 and a cooling capacity of 10 to 100 W/cm2 at room temperature.

PHASE I: Design and fabricate prototype electron emitting micro-structures using wide gap semiconductor materials. Demonstrate the feasibility of using the structures in cooling.

PHASE II: Fabricate and demonstrate prototype cooling devices. Integrate devices with microelectronics devices or optoelectronic devices to be cooled. Package the integrated micro-coolers and characterize their performance. Compare performance metrics with TEC devices fabricated from standard materials.

PHASE III DUAL USE APPLICATIONS: The integrated thermionic micro-coolers are expected to find applications in cooling of digital ASIC's in imaging and optoelectronic high-performance modules like transceivers in WDM systems. The military applications include cooling of radar power amplifiers, high-performance processors chips in image analysis.

KEYWORDS: Hot Electron Emission; Thermionic Micro-Coolers; Optoelectronic; Microelectronics; Cooling.

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SB002-043 TITLE: Micro-optical Switches

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop fast, fault-tolerant micro-optical switches for communication and computer networks.

DESCRIPTION: Switching is a central function in all communication and computer networks. The role of a switch in a network is to route signals to the desired destination. Most networks today use electronic switches to route signals. The drawback with electronic switches is that their operating bandwidth is limited by the electronics; these switches also tend to consume large amounts of power. Typical electronic switches have large form factors. For modern fiber-optic communication networks, the use of electronic switches imposes a severe bandwidth limitation since the fiber is capable of carrying signal traffic at much high data rates. A typical optical signal carried in a fiber must be converted to an electronic form before it can be routed by the electronic switch; once positioned for the right destination, this signal must again be converted to light before being launched into the appropriate fiber for re-transmission to its destination. Herein lies one of the several disadvantages of electronic switching in optical networks. Since there is a maximum limit to bandwidth for networks switched with electronics, this limitation constraints growth. In future networks, it will be important to build reconfigurable switches that are scalable so that as the demand for bandwidth grows, the switching function can also grow to accommodate the demand. These switches are likely to be optical. They will either operate as routers or simple optical cross-connects. The key ingredient in them is that they will handle the signal in its native form, i.e., optical, without conversion to electrical. When used as routers, the switches must also have provision for wavelength De-multiplexing/multiplexing in addition to the simple function of cross-connecting signals from input fibers to output fibers. The De-multiplexing/multiplexing functions make the switches compatible with wavelength division multiplexing networks. Recent advances in micro-machining and microelectronic fabrication technology indicate that these switches can be made using standard batch micro-fabrication techniques [1]. These developments will make it possible to design and manufacture compact switches, which are easy to interface with optical fibers as well as control electronics [2].

PHASE I: Design and fabricate a prototype 8 x 8 micro-optical cross-connect switch which can be scaled to a 48 x 48 module. The elements of the switch should occupy a total area no large than 2.5 sq. centimeters. The switching time of each mirror should be less than 2 milliseconds. The micro-mirror designs should carefully take account of how the unit will be interfaced with fibers. Design for switch scalability is required.

PHASE II: Fabricate and demonstrate a prototype switching module scaled to 48 x 48. Include control electronics in the module. The module should be compact when packaged with the routing fiber channels. Each channel of the switch should be capable of supporting optical transmission bandwidths of up to 40 Gb/s per channel. The overall system should carefully balance complexity, which may add versatility, at the cost of ease fabrication.

PHASE III DUAL USE APPLICATIONS: Large capacity micro-optical switches are important in wavelength division multiplexing (WDM) networks as well as in high-capacity military computer networks. Systems with switching capacities of 10 Tb/s are expected to be in use in future optical networks.

KEYWORDS: Wavelength Division Multiplexing, WDM, Micro-Optical Switches, Micro-Machining, Microelectronic Fabrication Technology.

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SB002-044 TITLE: Ultra-Fast Electronic Circuits for Advanced Wavelength Division Multiplexed Optical Networks

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop ultra-fast transmitter/receiver arrays to support parallel fiber-optic channels in wavelength division multiplexed (WDM) systems deployed in military platforms with on-board high capacity data networks.

DESCRIPTION: Many mobile military platforms, such as ships, aircraft, and tanks have a need for high capacity data networks with typical aggregate bandwidths on the order of terabits/second. Existing wire interconnections impose severe limitations on the high speed operation of these networks. Some of the factors that lead to the wire limitations include: the inherent Resistance x Capacitance (RC) limit of wires as signal conductors, the physical size of wires, and the high powers necessary to drive wire-based signal carrying conductors. In preparation to retrofit military platforms with high-capacity fiber-optic networks, ultra-fast transceivers are needed. The new generation of transmitters will use linear arrays of oxide-confined vertical-cavity surface-emitting lasers as sources. The corresponding receivers will use either p-i-n or metal-semiconductor-metal (msm) detectors. To design and fabricate transceiver modules capable of tens of Gigabits/second operation requires innovations in the design of the drive and amplifying electronics. The electronics can be manufactured from Silicon Complimentary Metal Oxide Semiconductor (Si CMOS) technology, SiGe technology, or III-V compound semiconductor technology. Since vertical-cavity surface-emitting lasers are capable of being modulated at rates in the 10's of Gigabits/second range, transceiver electronics should also be capable of signaling at comparable rates.

PHASE I: Design transmitter/receiver electronics (in III-V semiconductor technology, Silicon Germanium(SiGe) technology, or Si CMOS technology) capable of operating at rates in excess of 2.5 Gigabits/second per channel at 850 nm or 1.55 µm. Demonstrate a 4-channel, low power proof-of-concept transceiver/receiver array that can be mated to optical fiber ribbons or fiber arrays.

PHASE II: Design, fabricate and demonstrate a low power 16-channel transmitter/receiver array, including the packaging technology. Show how the transmitter and/or receiver can be scaled to 64-channels.

PHASE III DUAL USE APPLICATIONS: The technology developed under this SBIR can be used in high-end commercial wavelength division multiplexing (WDM) markets where data bandwidths in the terabits/second range are the norm.

KEYWORDS: Fiber-Optics, Wavelength Division Multiplexing Networks, WDM, Tranceivers.

SB002-045 TITLE: <u>Neutralization or Decontamination of Biological and Chemical Warfare Agents in a Building Interior</u>

TECHNOLOGY AREAS: Materials/Processes, Biomedical

OBJECTIVE: Development of the capability to render ineffective and non-lethal aerosolized biological and chemical agents, either during an attack (neutralization) or after the event (decontamination), with minimal damage to the building inhabitants and building surfaces.

DESCRIPTION: The threat of attack using biological or chemical warfare agents (BWA or CWA) is of increasing concern to U.S. forces today. Most effort to date has focused on these threats when used in a battlefield environment. However, other attack scenarios are possible, for example attacks against buildings such as those found on military bases. Such attacks could take the form of covert release of BWA or CWA, either directly inside the buildings, or outside and relying on outside-air exchange to bring the contamination indoors. In such scenarios, it would be necessary to deal with BWA or CWA contamination inside of buildings. Decontamination approaches in use today for battlefield applications are inappropriate in these situations, for example because of the caustic and toxic materials employed and because the very methods of employment would damage building materials. This SBIR topic is designed to address this need. DARPA is looking for revolutionary techniques to neutralize BWA or CWA in real time (during an attack on a building); and/or for techniques to decontaminate buildings after an attack. The following issues will be important in evaluating and ranking proposals: (1) Techniques should address the entire building problem rather than just a piece of it. For example, filtration can play an important role in capturing aerosolized agent; however, filtration alone does not address the problem of agent that is deposited on surfaces before passing through the filter. Therefore it is not a complete solution in the sense of this SBIR topic. (2) Techniques proposed should address as wide a range of agents as possible, rather than being applicable to a single agent, for example. Ideally, a technique would be appropriate to all types of CWA and BWA, including spores, toxins, viruses, etc. If this ideal is not met, techniques appropriate to BWA alone are of more interest than those appropriate to CWA. (3) Techniques should cause as little damage as possible (preferably no damage) to building surfaces, materials and contents. Similarly, they should have minimal environmental impact. Neutralization (real-time) techniques must minimize damage to human occupants of the building. (4) Whether used for neutralization or decontamination, techniques should allow the building to be brought back to full function as quickly as possible after an attack. (5) Techniques should be low cost, so that they can be widely applied to a large number of buildings. They should be easy to use for this application, including pre-event installation, post-event application, and post-event recovery from the application. Efforts may either modify existing technologies or develop new ones, but in all cases proposals must clearly state the expected neutralization/decontamination capabilities, specifying both the range of agents to which it is expected to apply and the conditions under which it can be used.

PHASE I: In detail define the neutralization and/or decontamination enabling technologies. Identify the physical mechanisms important in the process. Acquire data validating this basic phenomenology and describe techniques to apply this technology in a building-protection environment. Draft a concept of operations using the technologies and describe the technical approach (including phenomenology), the enabling technologies, the control systems, the range of agents addressed, the estimated efficiency of the process, the effects on human occupants and building readiness, and any inherent limitations. The proposed technologies may encompass the spectrum of developmental or emerging to breakthrough technologies.

PHASE II: Refine the concept of operations using the proposed technology to protect building occupants from harm and to restore the building to full-function after an attack. Develop a model of the process taking into account building characteristics and predict neutralization or decontamination efficiencies for all relevant agents and concentrations; the expected dosage of occupants during an agent release (for neutralization techniques); and the time required to eliminate the agent or to decontaminate the building and return it to full functionality. Develop a working prototype and validate the process model through test and evaluation, using simulants that mimic the physical mechanisms identified in Phase I.

PHASE III DUAL USE APPLICATIONS: The development of neutralization techniques that can eliminate airborne biological material and volatile organic chemicals from the air holds significant promise for addressing rapidly growing indoor air quality concerns. This technology would provide substantial benefits for any enclosed space where air quality and purity is important, such as hospital operating rooms, commercial airliners, submarines. It could be used to address buildings with "sick building syndrome."

KEY WORDS: Chemical / Biological Defense, Neutralization, Decontamination, Indoor Air Quality, Sick Building Syndrome, Virus, Bacteria, Anthrax, Filters, Sterilization.

SB002-046 TITLE: Automated Battle Damage Indication from Synthetic Aperture Radar Imagery

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Develop automated approaches to detecting the presence of subtle damage to military ground vehicles by interpreting pre-strike and post-strike target signatures from stand-off airborne synthetic aperture radar (SAR) sensors. The principle focus of this research should be on the detection of limited damage associated with small, smart weapons. Work in this area should enable the near-real time, in-theater assessment of weapons effects using existing airborne sensor systems.

DESCRIPTION: Today, strike effectiveness is typically assessed through manual image interpretation of battle damage. Current and next-generation smart munitions will use significantly less energetic material and may utilize sub-munitions to achieve alternative kill mechanisms (such as small explosively formed penetrators for top attack or flechettes). These weapons may be deployed to attack a variety of ground order of battle targets such as tanks, air defense systems, artillery and command and control vehicles. Such weapons may produce a much smaller visible damage signature, making the task of manual image interpretation significantly more difficult. Traditional battle damage assessment (BDA) techniques have focused on optical imagery and have been directed at detection of large effects, such as the presence of debris fields or significant structural damage. This effort is directed at the development of novel techniques to detect and assess more subtle vehicular damage indication associated with smaller weapons. These effects may include small entry and exit holes, local geometric distortions due to overpressure, perforation of surfaces, or changes in attitude or configuration. It is anticipated that many of these effects will be confined to local regions of the target, and may be of a scale smaller than the SAR imaging resolution. This problem differs significantly from previous efforts focused on target recognition from SAR sensors for battlefield awareness and targeting missions. To address the SAR BDA problem, we assume the availability of multi-look imagery of the target, collected pre- and post-strike. The real-time SAR BDA problem attempts to identify and characterize signature differences between these two signature collections and to attribute these changes to particular weapon-target interactions, permitting assessment of the effectiveness of the engagement. This effort seeks to identify techniques to automatically assess target damage using pre- and post strike target signatures collected from stand-off airborne SAR imaging systems. It is desired that these techniques be robust and capable of detecting and assessing vehicle damage associated with small sub-munitions. It is further desired that these techniques be capable of near-real time implementation, to permit timely and accurate assessment of strike effectiveness.

PHASE I: Development and assessment of software and algorithms capable of real-time assessment of a limited number of weapons effects appropriate to small sub-munition engagement of soft mobile targets. Assessment should focus on demonstration of robustness of approach, using simulated SAR target signature data.

PHASE II: Development, evaluation and demonstration of a functioning real-time system capable of assessing battle damage signatures over a large range of target-weapon interactions.

PHASE III DUAL USE APPLICATIONS: The development of advanced automatic battle damage indication detection approaches for use with airborne sensors offers significant advantages in the growing application of commercial airborne and space-borne remote sensing data to problems such as land use planning, demographic analysis and disaster relief planning. Commercial analogues to the battle damage indication problem exist in detection and diagnosis of advance medical imagery; including automated processing and interpretation of tomographic radiography (CAT scans) and magnetic resonance imagery (MRI). It is anticipated that successful real-time SAR BDA technologies will also be directly applicable to a variety of civilian monitoring applications, such as the evaluation and assessment of large structures (such as pipelines, oil platforms, and power production facilities). Such nondestructive evaluation techniques would offer significant advantages over current practice, as they could be performed quickly, from significant distance, and without effecting operations at the evaluation site. Additional applications are anticipated in treaty compliance assessment and monitoring.

KEYWORDS: Synthetic Aperture Radar; SAR; Battle Damage Indication; Battle Damage Assessment; BDA.

SB001-047 TITLE: Quasi-Phase Matching Structures in Semiconductors

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: The goals of the program are to develop innovative approaches for the growth of quasi-phase matching structures in semiconductors and demonstrate nonlinear frequency conversion devices in the mid-infrared spectral regions for high average output power.

DESCRIPTION: Quasi-phase matching (QPM) is a technique, which overcomes the usual coherence or phase match limitation in nonlinear optical interactions for nonlinear frequency generation within the transparency region of the material. By modulating the sign of the susceptibility of a nonlinear material, i.e., by periodically changing the orientation of the crystal axis the phases of interacting lightwaves could be manipulated to control the flow of energy among interacting lightwaves. Most recently, this technique has been extended from thin films and wave guides to bulk crystals through periodically poled wave guides in lithium niobate using the proton exchange technique and bulk periodical poling in lithium niobate using a high field technique1. Nonlinear frequency conversion in the mid infrared has since been demonstrated by numerous researchers. Compound semiconductor materials have high nonlinear coefficients and damage thresholds compared to lithium niobate and extend the transparency region well into the infrared beyond five micrometers. Diffusion bonding of thin plates of Gallium Arsenide with opposite nonlinear susceptibilities for QPM structures has previously been demonstrated2. The process is tedious and requires difficult assembly. Recently QPM structures in gallium arsenide epitaxial structures have been demonstrated for second harmonic generation in the mid-infrared spectral region. QPM structures in semiconductors holds out the promise of low cost, highly efficient devices for nonlinear frequency conversion at high average output power and can be packaged with semiconductor lasers for numerous defense and commercial applications.

PHASE I: Develop and demonstrate innovative epitaxial growth techniques for QPM structures in semiconductors for frequency conversion in the mid infrared spectral regions. Demonstrate device operation for mid-infrared frequency generation.

PHASE II: Demonstrate reproducible growth techniques and reliable device operation at high average powers.

PHASE III DUAL USE APPLICATIONS: The QPM semiconductor structures have many commercial applications in telecommunications, gas sensing and medical applications. A successful demonstration will have defense and commercial applications.

KEY WORDS: Quasi-Phase Matching, Nonlinear Frequency Conversion, Semiconductors.

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SB002-048 TITLE: Three Hundred Sixty-Degree, 3-D Near-Vehicle Situational Awareness System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

OBJECTIVE: Provide a very close range, very-low signature emission, and stereoscopic three-dimensional surveillance capability to enhance the situational awareness and survivability of personnel and battlefield assets. It is also desired that this solution provide a capability to achieve detection of very low signature targets.

DESCRIPTION: This effort must provide a capability for very close-in high-fidelity stereoscopic surveillance in the immediate vicinity of friendly troops and vehicle assets. Characteristics should include 360 degree field of operation providing 3-D Near-Vehicle Situational Awareness information to mounted or dismounted assets mounted on or off vehicle and emitting at very low signature. Minimal close-in detection ranges are on the order of three (3) meters. This system should be designed for a low probability of detection requiring minimal human interface. The system must be all weather and non-destructive. There are a number of sensors (some that are known and some that might have to be developed) that could be developed/integrated to meet this criterion. There are also several related efforts addressing similar issues. Typical of these efforts, which do not include human eye augmented stereoscopic capabilities nor very low signature capabilities, include:
1. A see-through tank-turret design ("Glass Turret") that employs a head-track sensor for the fusing of multiple steering arrays and addresses the parallax and fusing of distributed aperture steering arrays.
2. A 360vision distributed aperture high-frame rate capability being developed under the Joint Tactical Fighter (JTF) program for fighter applications.
3. The Night Vision & Electronic Sensors Directorate (NVESD) low-cost head-track sensor that couples an uncooled sensor with flash laser imagery to address all-around vision target recognition and identification at short to medium ranges.
4. NVESD head-track sensor for fusing infrared and image intensification for drivers.
5. The Future Scout Cavalry System (FSCS) ATD which is looking at several distributed aperture candidates to achieve all-around vision.
The offeror has significant latitude in designing and developing this system. These systems could include active emitters (radar, Light Detection and Ranging ((LIDAR)), microwave, passive and active acoustics, etc), passive devices (detectors, optics, etc.), tactile devices, etc.

PHASE I: Identify enabling technologies and system requirements to achieve the required capabilities. Identify package options and capabilities as well as performance requirements to support small unit operations as well as those requirements associated with being part of a larger information exchange and situational awareness infrastructure. Develop solution architecture and perform limited breadboard tests to demonstrate feasibility.

PHASE II: Build prototype system, develop test plan, define required test support assets and work cooperatively with DARPA and the Army to demonstrate solution effectiveness.

PHASE III DUAL USE APPLICATIONS: This technology could be used in support of commercial vehicular systems like large trucks, in support of fire and rescue equipment, in support of automobile alarms, and visual impairment support for sight impaired people.

KEYWORDS: Situational Awareness, Near-Field Surveillance, Sensors, Sensor Fusion, Electronics.